

NE 515 - Final Exam

All problems will have the following characteristics unless otherwise stated.

- a. 1-D slab geometry.
 - b. Slab thickness = 25 *cm*.
 - c. Spatial zoning = 100 uniform cells.
 - d. Constant isotropic distributed source (Q_0 *p/(cm³ - sec)*).
 - e. Incident flux at right boundary ($2\pi \int_{-1}^0 f(\mu) \mu d\mu = 1$).
 - f. Vacuum condition at left boundary.
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- 1. Using diffusion theory, diffusion theory with FSDS, and S₁₆ theory with Lobatto quadrature, calculate the scalar flux for the model problem with a plane-wave boundary flux, no distributed source, $\sigma_t = 1.0$ *cm⁻¹*, and $\sigma_a = 0.0$ *cm⁻¹*. Plot the scalar flux solutions as a function of space and explain the results. (All three plots should be placed in one figure.)
 - 2. Same as Problem 1, except that the boundary flux is isotropic, Gauss quadrature is used in the S₁₆ calculation, and the boundary condition at the left face is reflective.

3. Using diffusion theory and S_{16} theory with Gauss quadrature, calculate the scalar flux for the model problem with a unit distributed source ($Q_0 = 1 \text{ p/(cm}^3 - \text{sec)}$), a vacuum boundary condition at the right face, $\sigma_t = 0.1 \text{ cm}^{-1}$ and $\sigma_a = 0.05 \text{ cm}^{-1}$. Then repeat the calculation with $Q_0 = 0.1$, $\sigma_t = 1.0$, and $\sigma_a = 0.005$. Finally, repeat the calculation with $Q_0 = 0.01$, $\sigma_t = 10.0$, and $\sigma_a = 0.0005$. Plot the solutions and explain the results. (All three plots should be placed in one figure.)
4. Using S_{16} theory with Gauss quadrature, calculate the scalar flux for the model problem with a unit isotropic distributed source ($Q_0 = 1 \text{ p/(cm}^3 - \text{sec)}$), a vacuum condition at the right boundary, and $\sigma_t = \sigma_s = 1.0 \text{ cm}^{-1}$. Then repeat the calculation with $\sigma_t = \sigma_s = 1.5 \text{ cm}^{-1}$, and $\sigma_1 = 0.5 \text{ cm}^{-1}$. Finally, repeat the calculation with $\sigma_t = \sigma_s = 1.5 \text{ cm}^{-1}$ and $\sigma_1 = \sigma_2 = \dots = \sigma_{15} = 0.5 \text{ cm}^{-1}$. Plot the scalar flux solutions and explain the results. (All three plots should be placed in one figure.)
- * The positive cosines and weights follow for an S_{16} Lobatto quadrature set. These weights sum to one on the half-range rather than one-half, but the code normalizes the weight to sum to unity over the full range.

.1013263	.2998305	.4860594	.6523887	.7920083	.8992005	.9652460	1.0
.2019583	.1936900	.1774919	.1540270	.1242554	.0893937	.0508504	.0083333